

Engineering the Future of Health

ASEE 2019 Engineering Deans Council

Bruce J. Tromberg, Ph.D.

Director

National Institute of Biomedical Imaging and Bioengineering



Creating Biomedical Technologies to Improve Health

HOME

RESEARCH FUNDING

LABS AT NIBIB

TRAINING & CAREERS

NEWS & EVENTS

SCIENCE EDUCATION

ABOUT NIBIB



Nano-generated electric pulses reduce weight and heal wounds

Bioactive scaffolds guide sore knee relief

Bruce Tromberg assumes NIBIB Director post

Wearable ultrasound patch measures central blood pressure

Videos And More



7 MORE Awesome Technologies Your Tax Dollars are Paying to Create

[VIEW MORE](#) ▶

NIBIB News & Highlights



Taking the sting out of diabetic testing
February 1, 2019



Using inkjet printers to build a new biosensor for less invasive breast cancer detection
December 7, 2018

Screenshot

Funding Opportunities



Scientific Program Areas



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- RESEARCH FUNDING
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22 Days

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Disclosures

No Financial Interests

Background

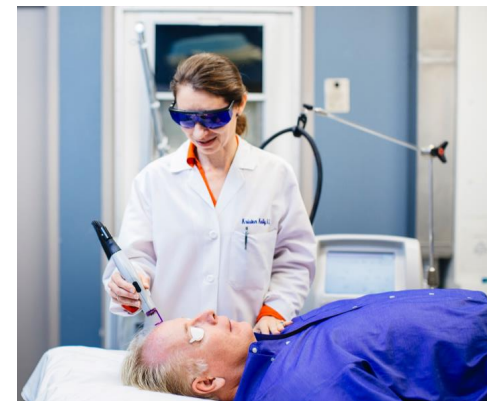
UC Irvine (1988): Beckman Laser Institute and Medical Clinic



Optics and Photonics Biology & Medicine
~200 people, 22 faculty, 10 departments



Clinic & Operating Room, Translational Research, Basic Science and Technology, Philanthropy, Commercialization

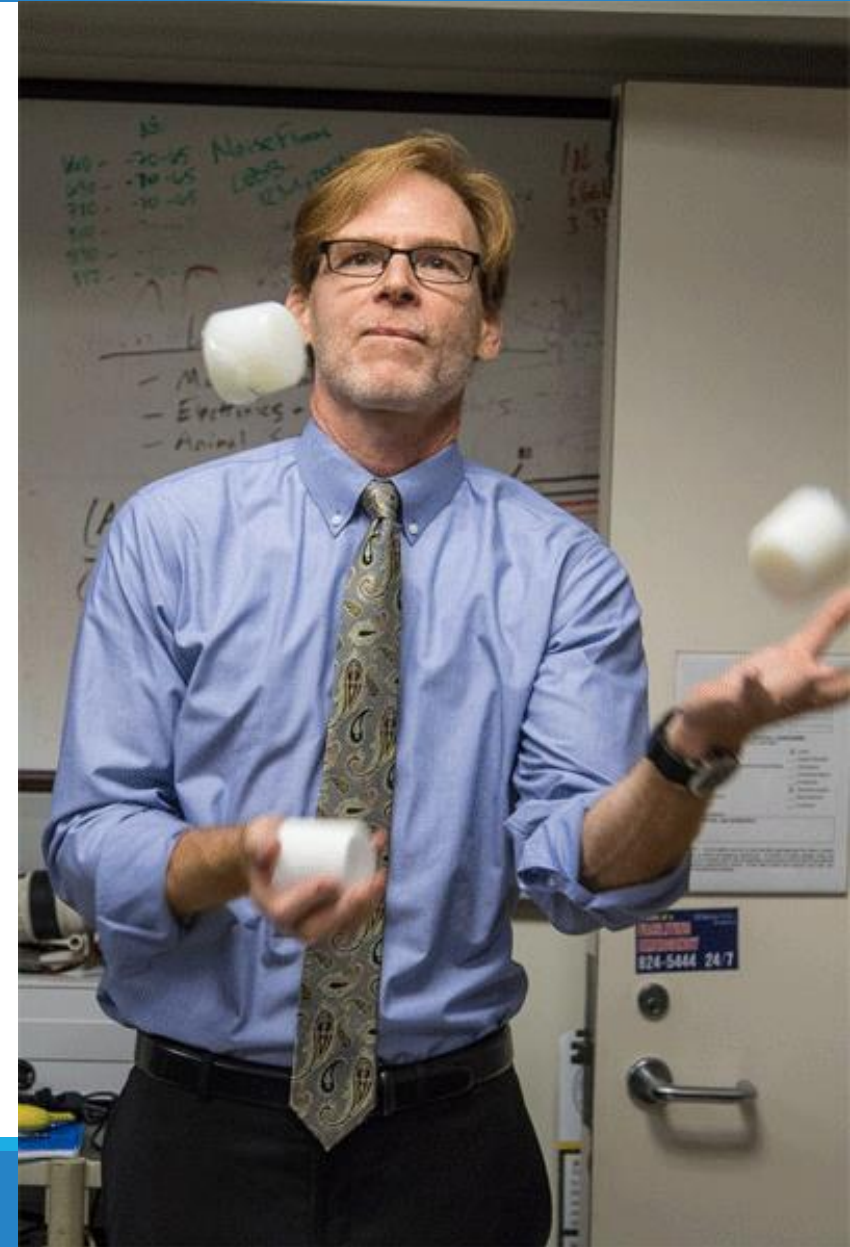


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Acknowledgements



Jill Heemskerk, Ph.D.
Deputy Director



David George, Ph.D.
Associate Director Research Admin

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Roderic Pettigrew, M.D., Ph.D.
Founding Director, NIBIB

Creation of NIBIB

PL 106-580: Dec 29, 2000; NIBIB Opened in 2002



Public Law 106–580
106th Congress

An Act

Dec. 29, 2000
[H.R. 1795]

To amend the Public Health Service Act to establish the National Institute of Biomedical Imaging and Bioengineering.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

National
Institute of
Biomedical
Imaging and
Bioengineering
Establishment
Act.
42 USC 201 note.
42 USC 285r
note.

SECTION 1. SHORT TITLE.

This Act may be cited as the “National Institute of Biomedical Imaging and Bioengineering Establishment Act”.

SEC. 2. FINDINGS.

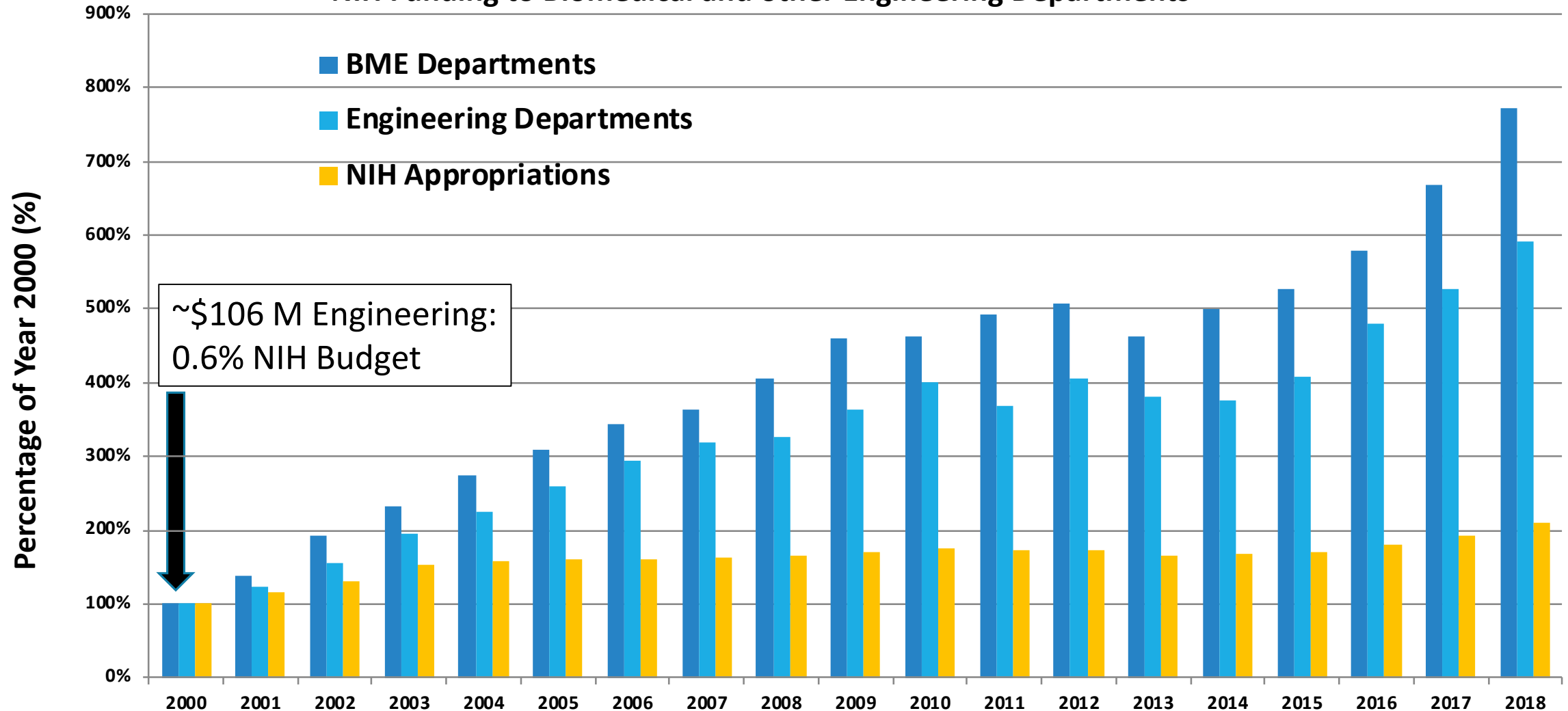
The Congress makes the following findings:

(1) Basic research in imaging, bioengineering, computer science, informatics, and related fields is critical to improving health care but is fundamentally different from the research in molecular biology on which the current national research institutes at the National Institutes of Health (“NIH”) are based. To ensure the development of new techniques and tech-

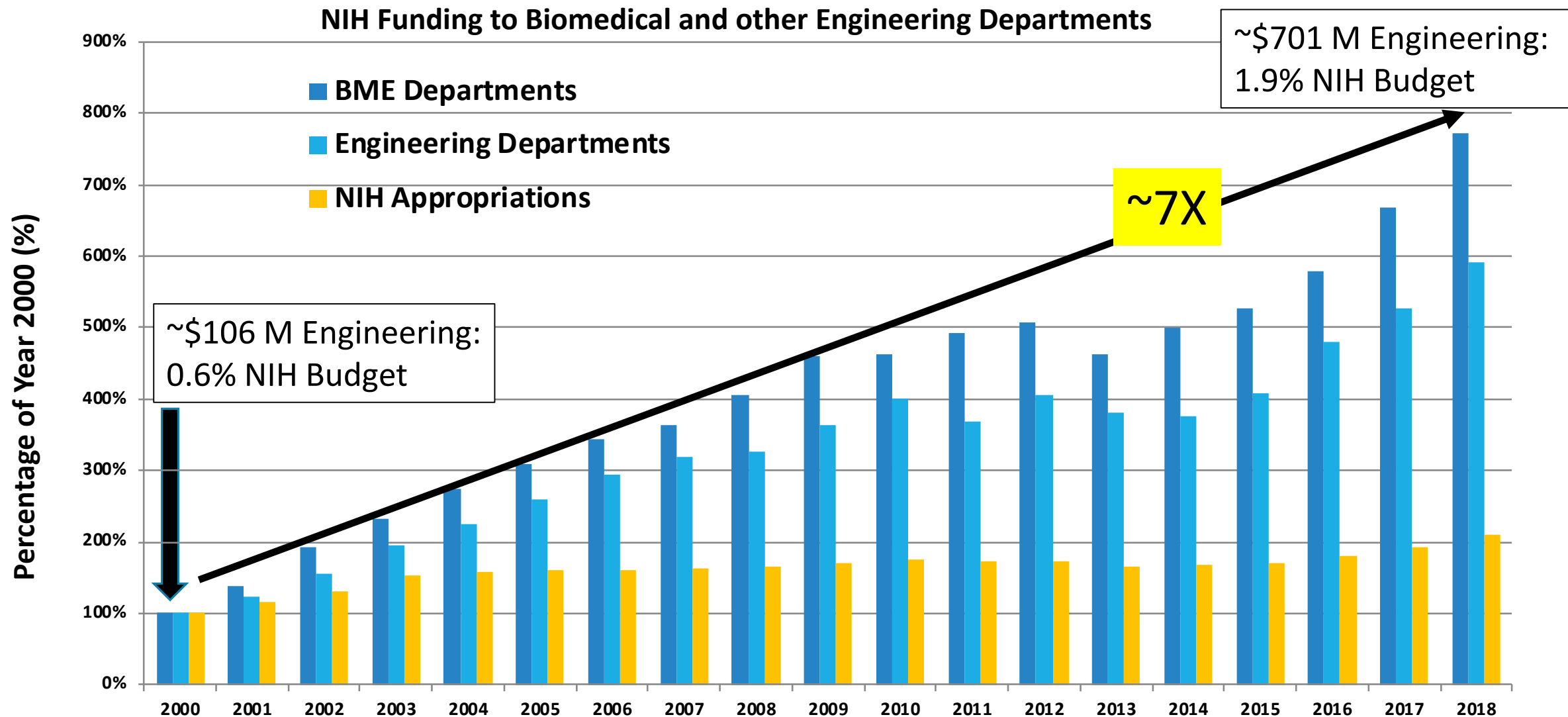
~~development of new, noninvasive imaging technologies for earlier~~

NIBIB Impact

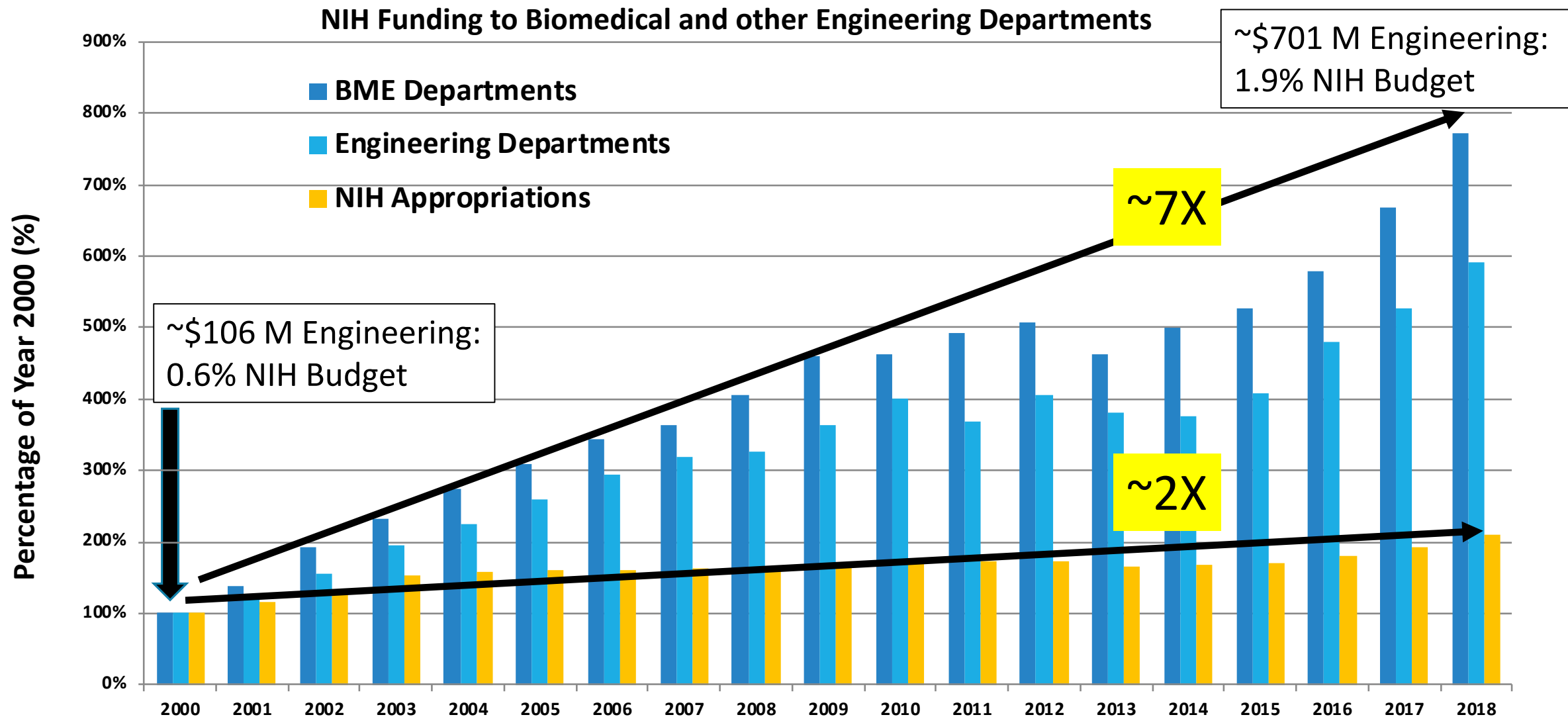
NIH Funding to Biomedical and other Engineering Departments



NIBIB Impact

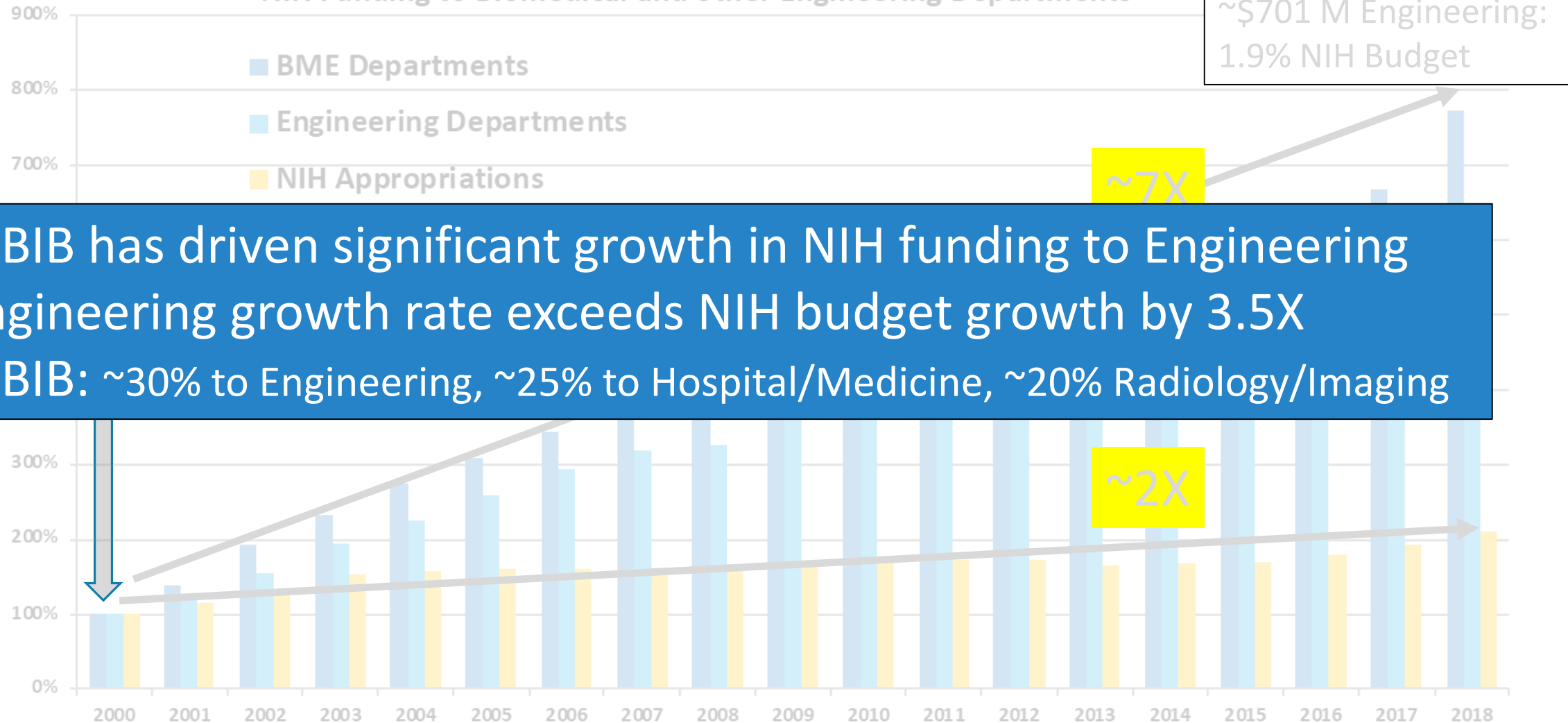


NIBIB Impact



NIBIB Impact

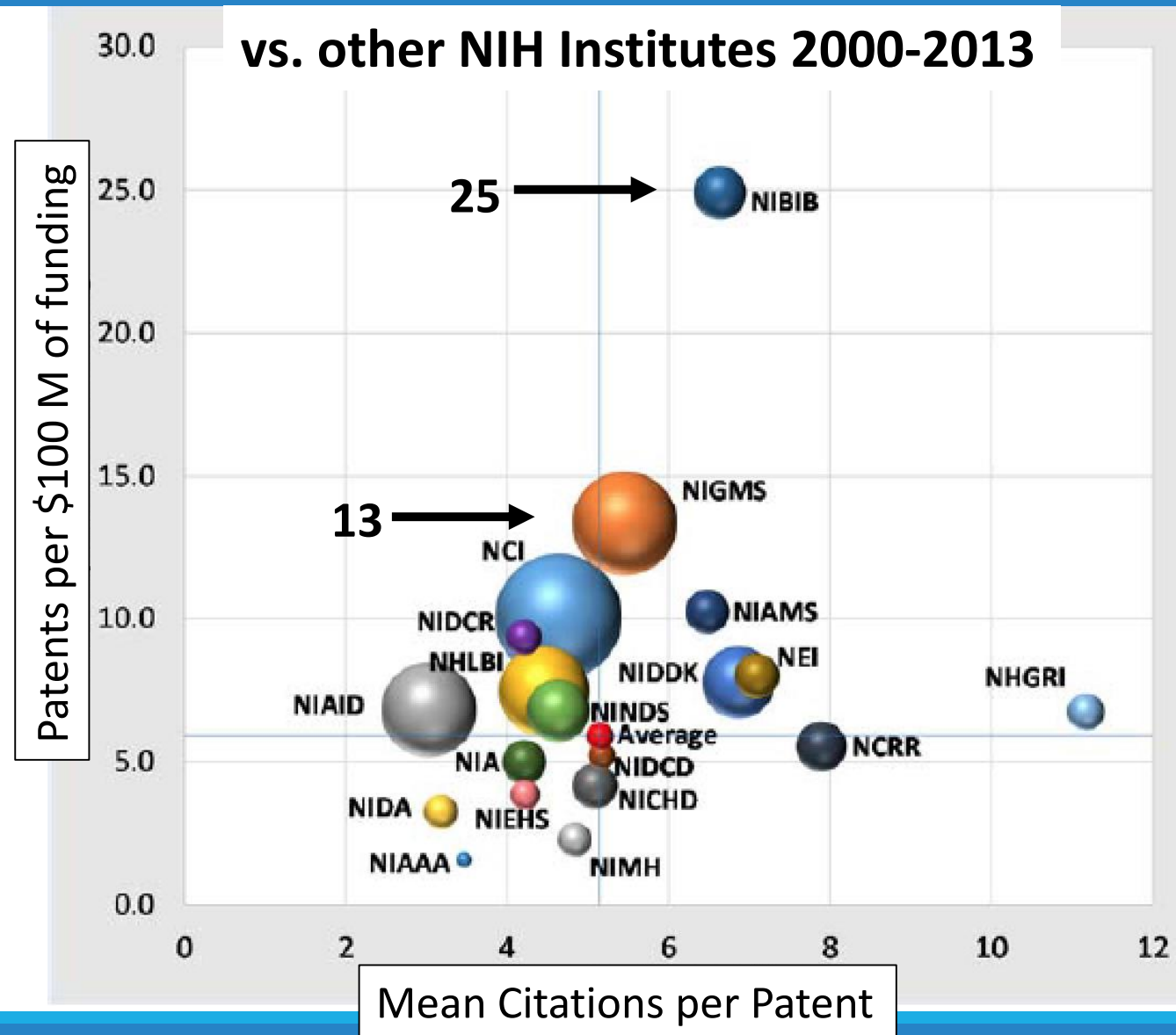
NIH Funding to Biomedical and other Engineering Departments



- NIBIB has driven significant growth in NIH funding to Engineering
- Engineering growth rate exceeds NIH budget growth by 3.5X
- NIBIB: ~30% to Engineering, ~25% to Hospital/Medicine, ~20% Radiology/Imaging

NIBIB Impact: *Patents*

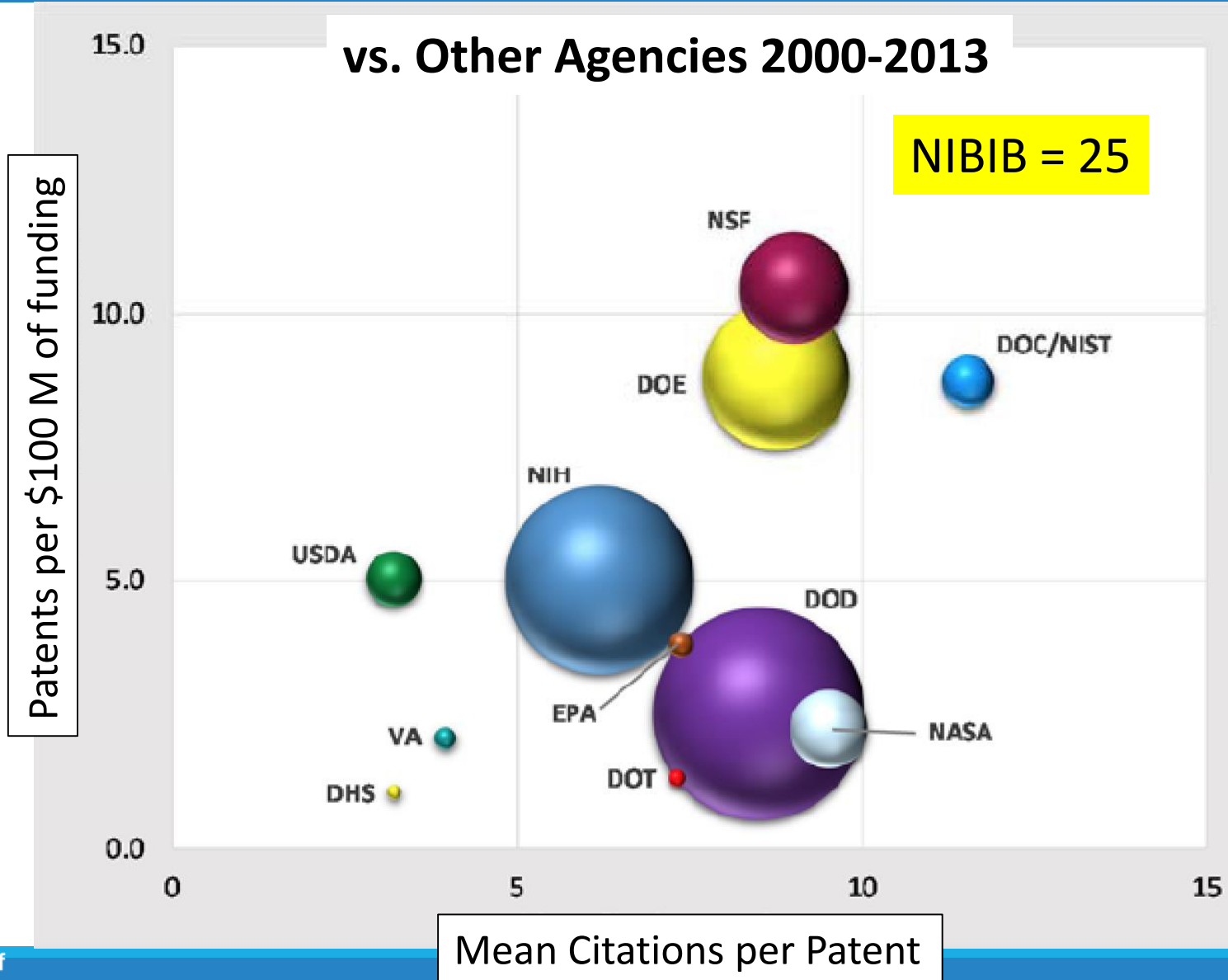
N = 20,441
“Average” = 250



Patents as Proxies Revisited:
NIH Innovation 2000 to 2013
Battelle, March 2015

NIBIB Impact: *Patents*

N = 63,699
Patents



Patents as Proxies Revisited:
NIH Innovation 2000 to 2013
Batelle, March 2015

2019: NIBIB Expanding Mission

Engineering and Physical Science in Biology and Medicine

- ***Human Health a top priority of Engineering Schools***
 - Adding ~1600 UG BME students, ~70 BME faculty/year*
 - ~30 ABET BME depts when NIBIB started, >100 in 2019*
- ***Medicine-Engineering partnerships: "Engineer-Physicians"***
- ***Drive Human and Economic Health***

* R. Hart, Annals BME, 2015

2019: NIBIB Expanding Mission

Engineering and Physical Science in Biology and Medicine

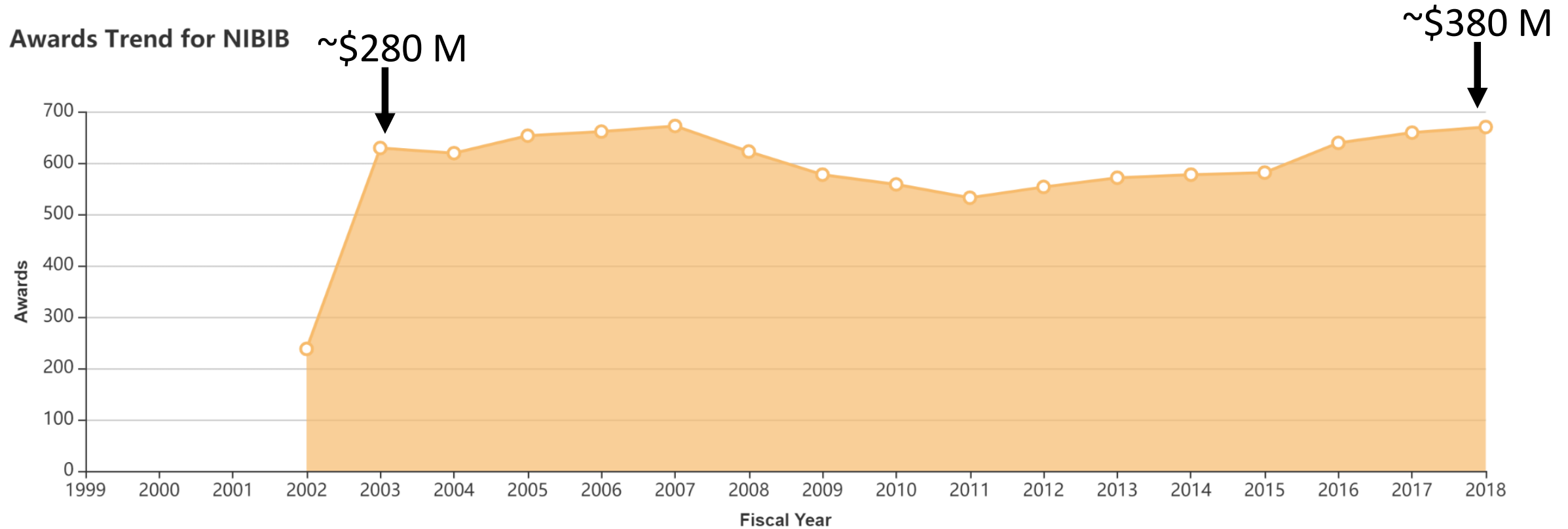
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NIBIB Resources insufficient to meet demands

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* R. Hart, Annals BME, 2015

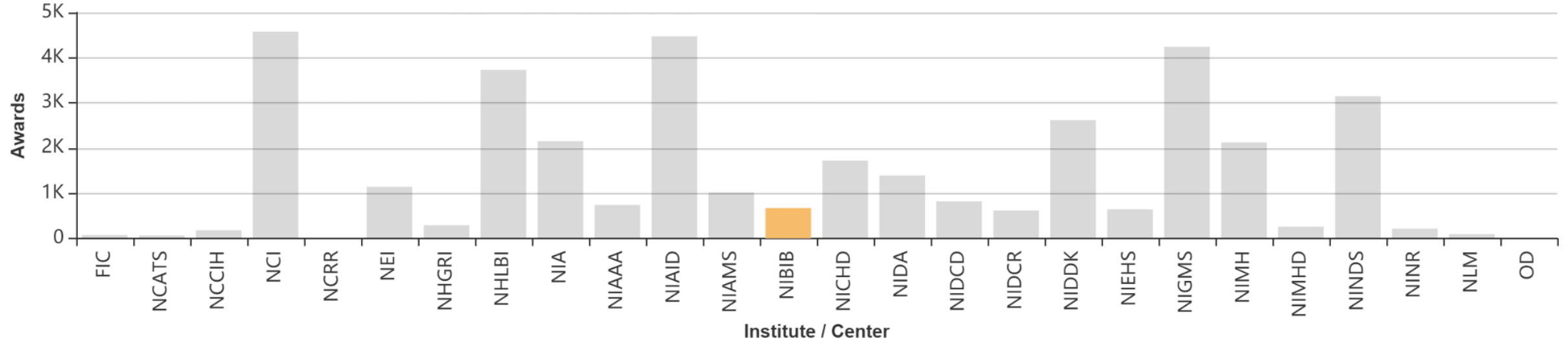
NIBIB Awards



NIBIB Awards vs. All NIH

Research Project Grants: Awards, by Institute / Center

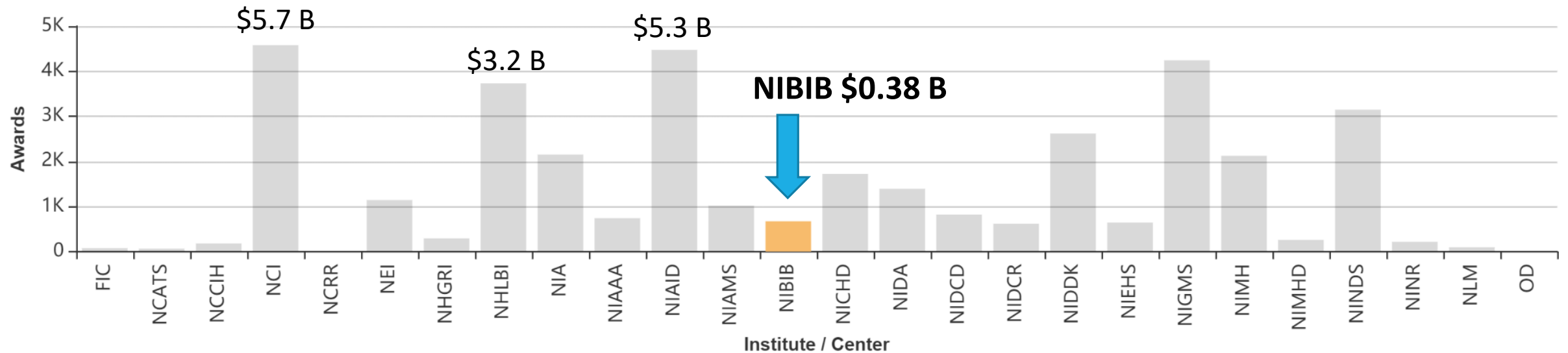
Awards for 2018



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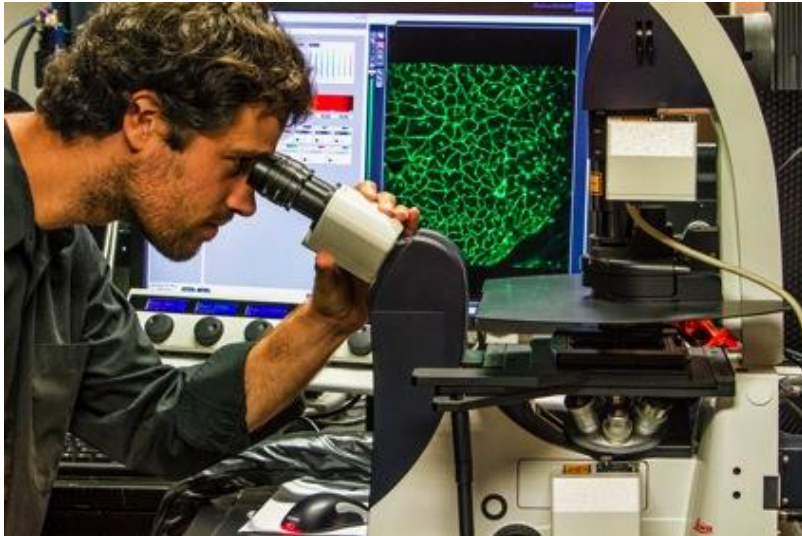


Vision

**Basic Science and
Technology Development**

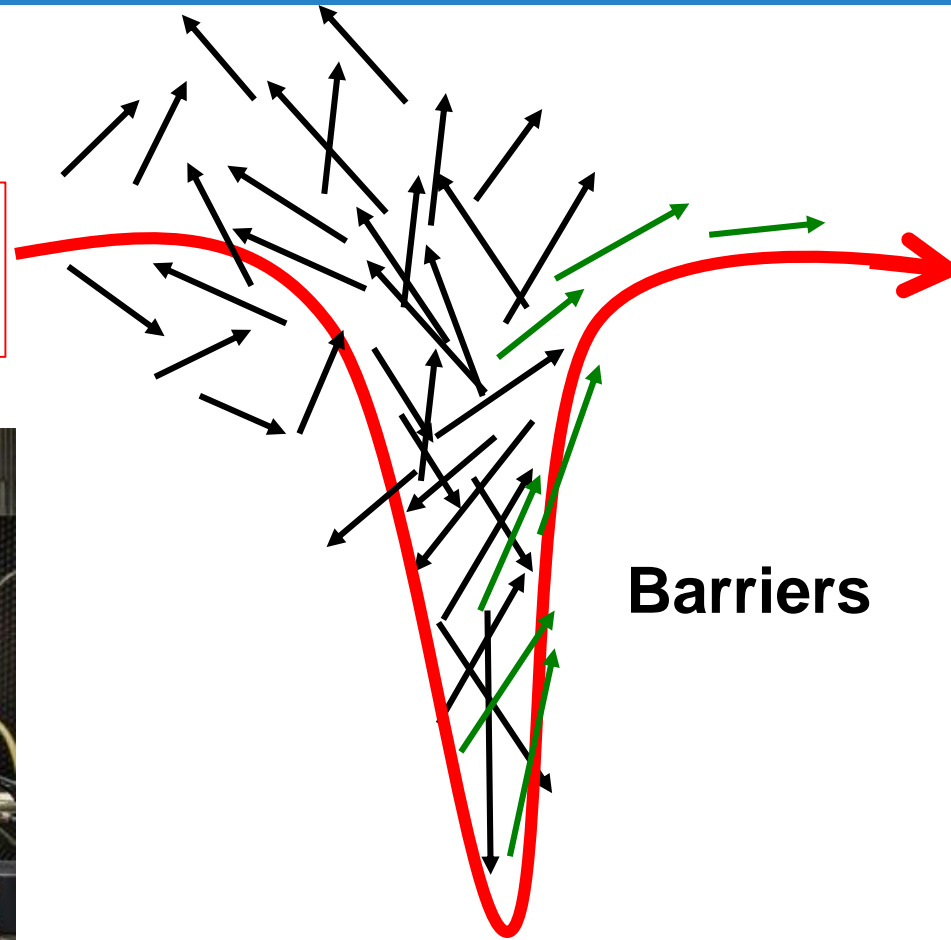
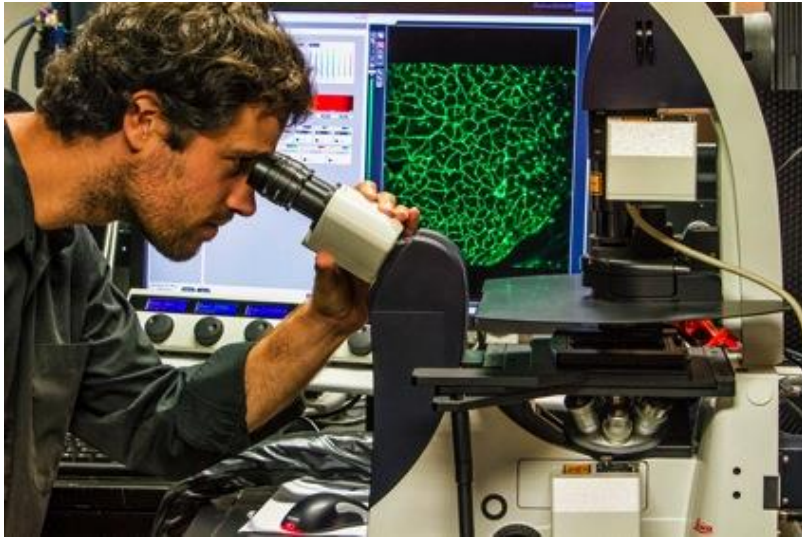


**Clinical Diagnostics
and Therapeutics**



Reality

**Basic Science and
Technology Development**

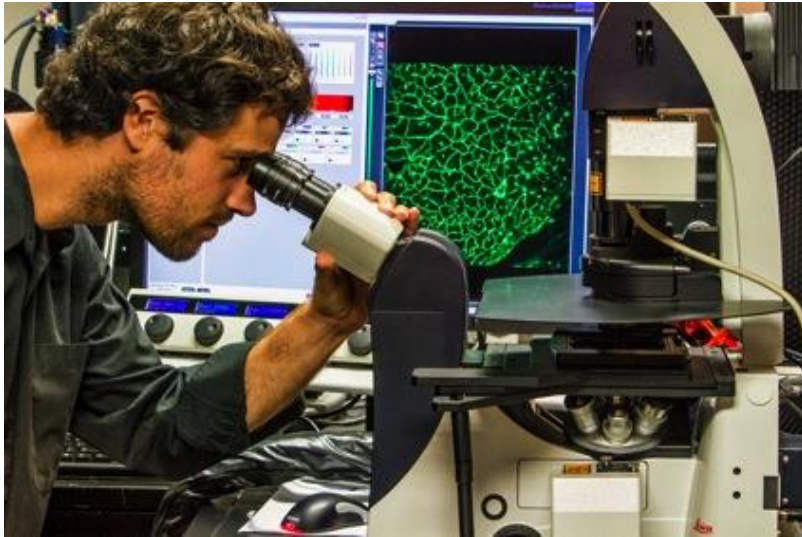


**Clinical Diagnostics
and Therapeutics**

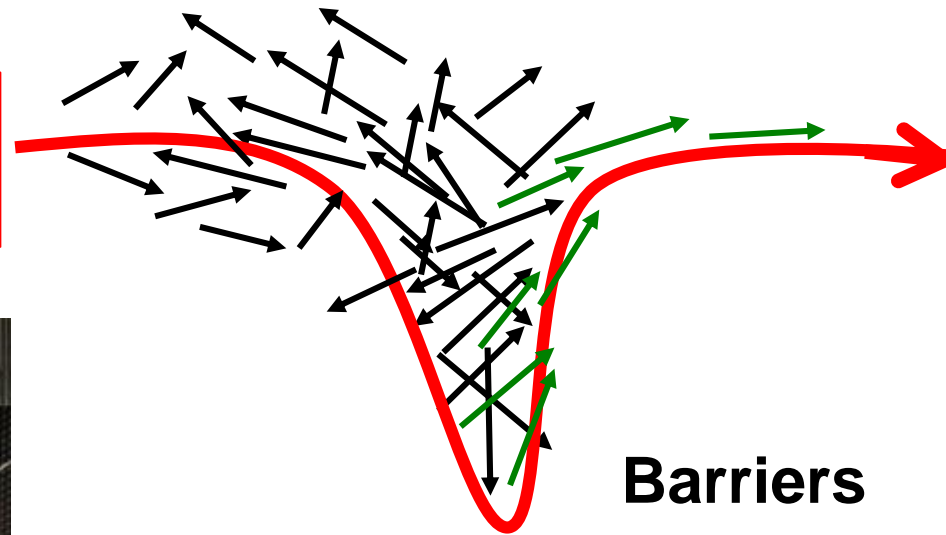


Shift Equilibrium *to Right*

**Basic Science and
Technology Development**



Increase activity



Barriers

Reduce
Barriers



**Clinical Diagnostics
and Therapeutics**



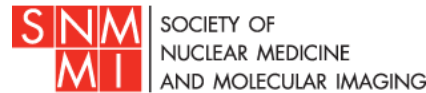
Accelerate Translation,
Validation, Commercialization



Engage Stakeholders

Engineering and Physical Science in Biology and Medicine

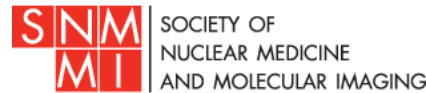
Universities, Professional Societies, National Academies, Federal Agencies, Foundations, etc.



Engage Stakeholders

Engineering and Physical Science in Biology and Medicine

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Create New Initiatives and Resources for NIBIB community



Engagement Opportunities

1) NIBIB Strategic Plan

- Council, stakeholders
- Structure NIBIB programs, initiatives to align with SP

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- Data analytics on grants, investigators
- Ensure meeting community needs, driving innovation/discovery

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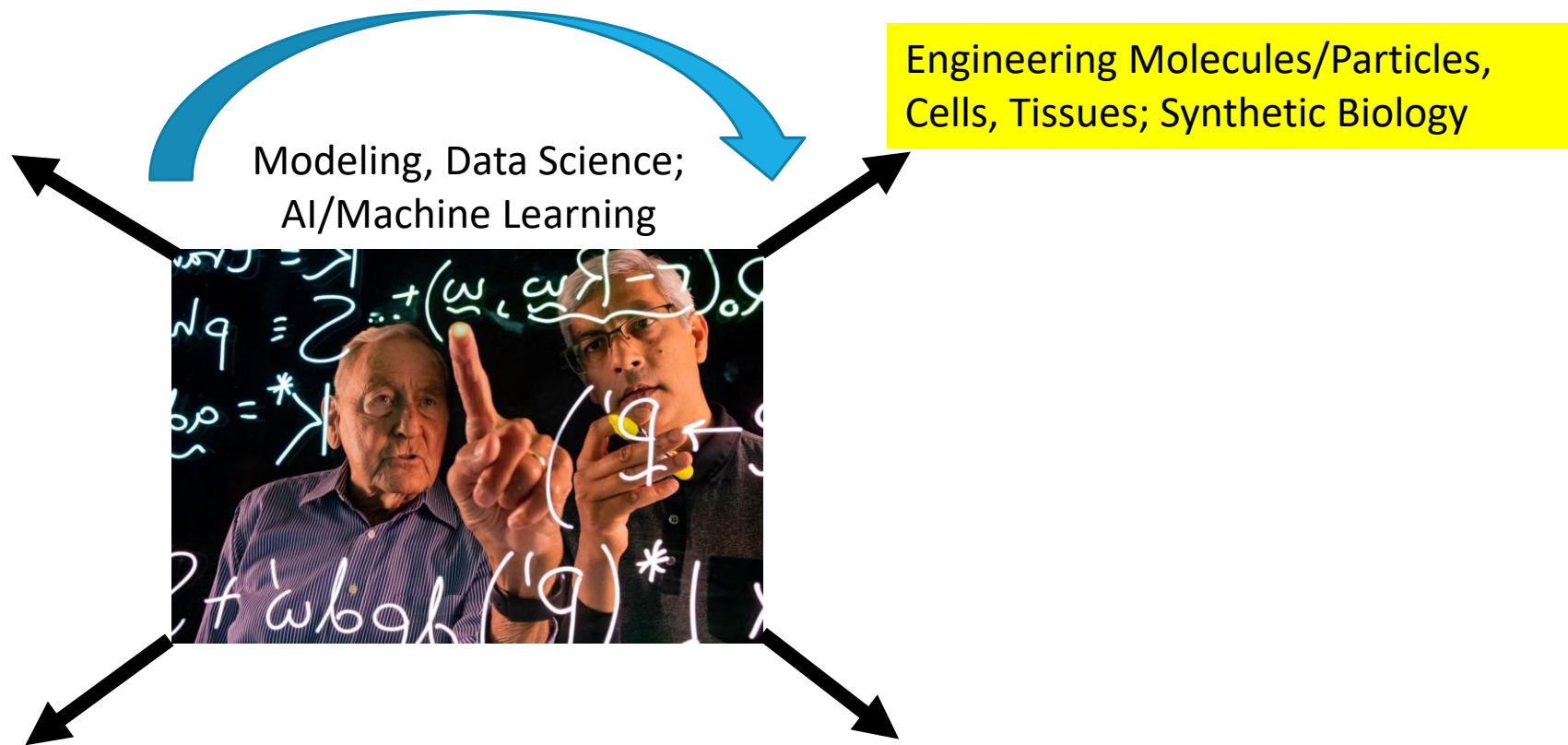
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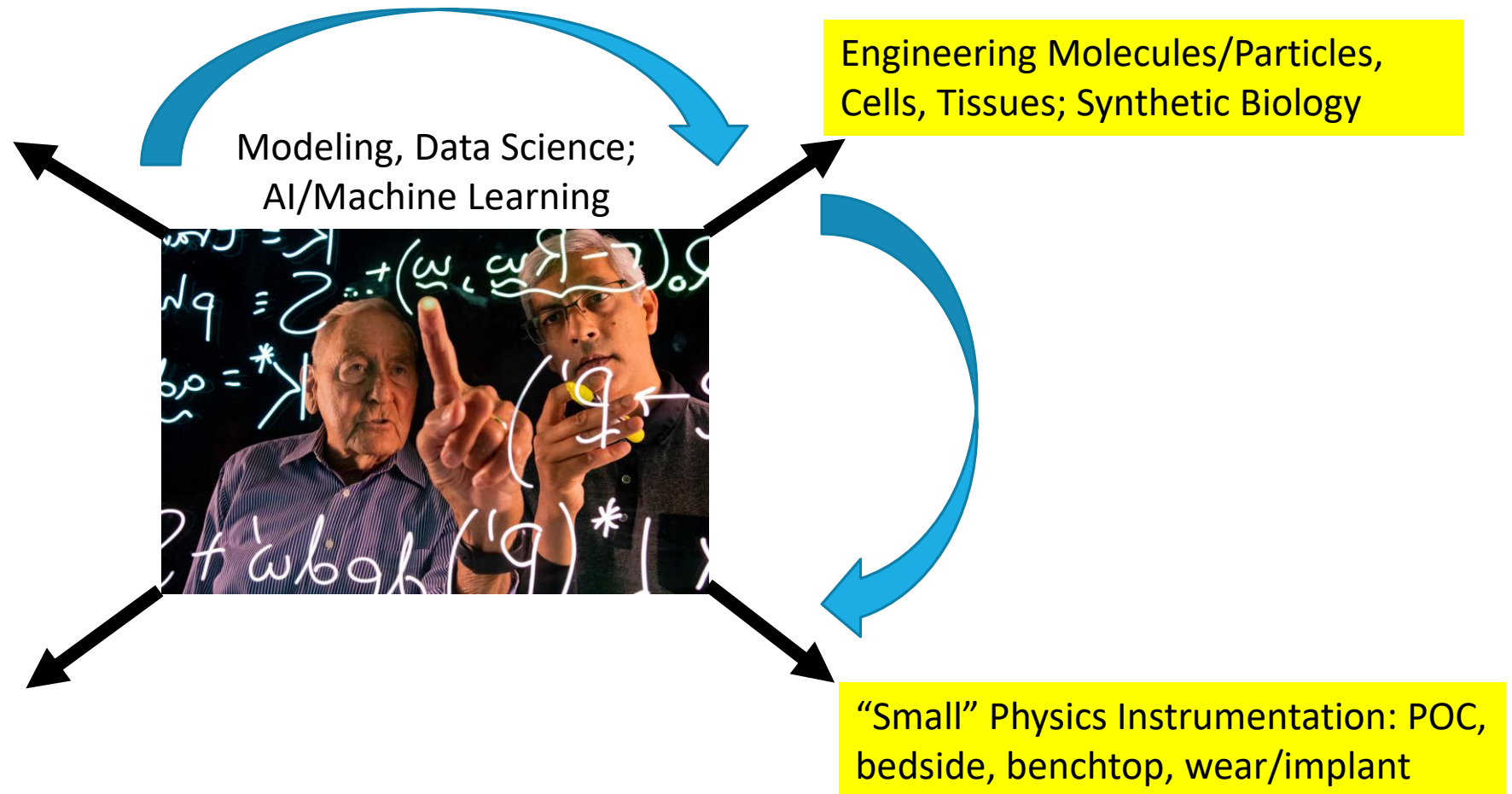
3) Outreach and Leadership

- NIBIB mission essential for *Human* and *Economic* health
- Define Vision for the Future of Health

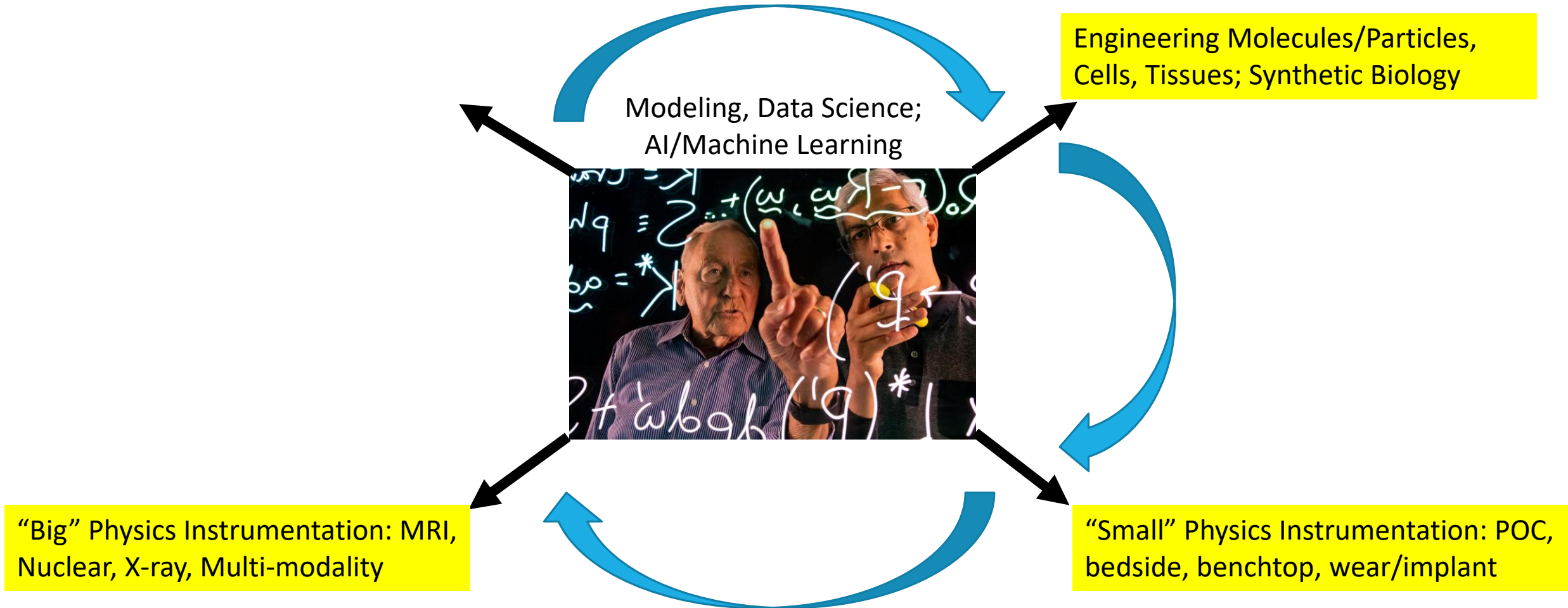
Vision for Future of Health



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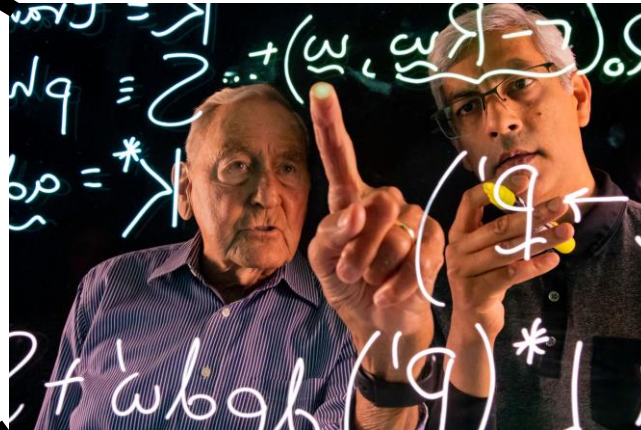


Vision for Future of Health

Therapeutics: energy-based, molecule- device combos, image guided

Engineering Molecules/Particles, Cells, Tissues; Synthetic Biology

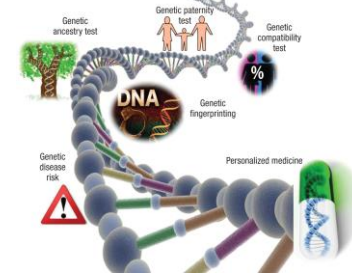
Modeling, Data Science; AI/Machine Learning



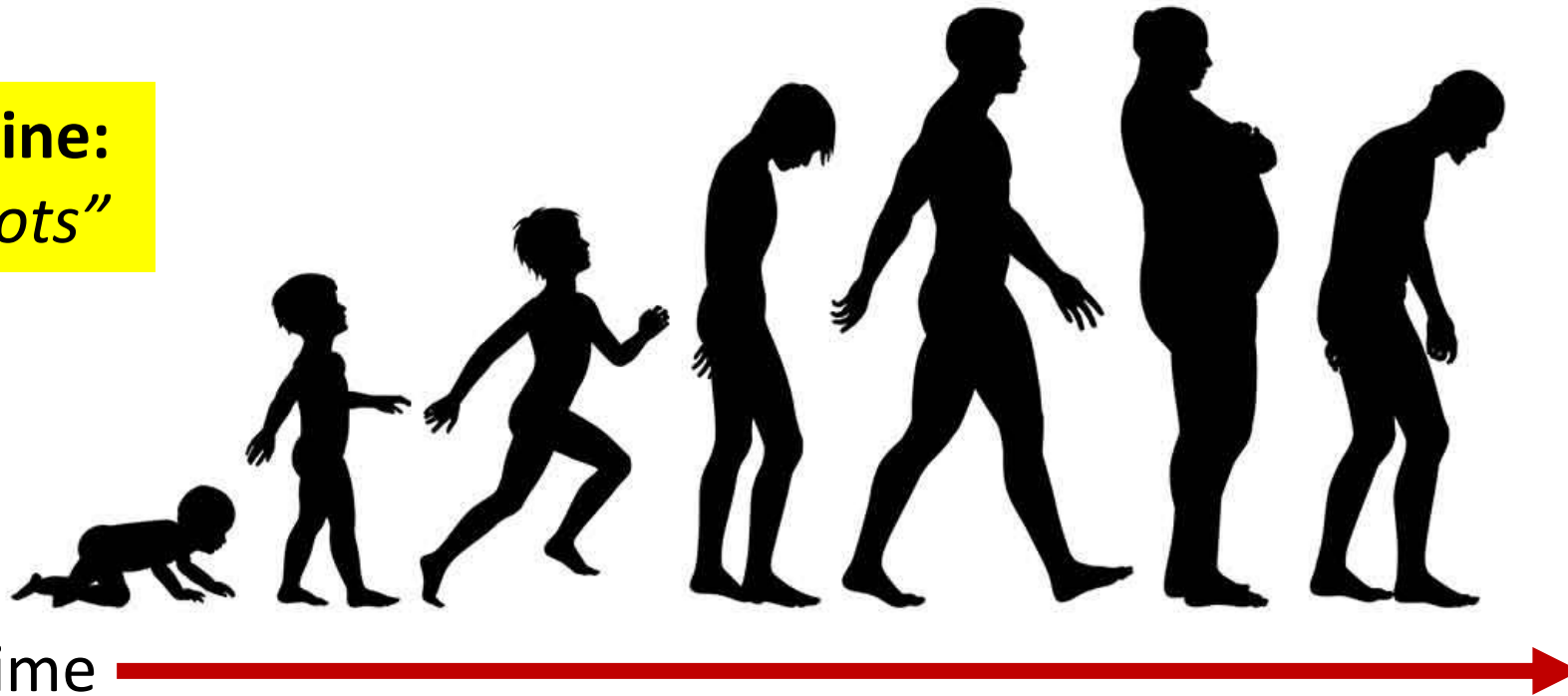
“Big” Physics Instrumentation: MRI, Nuclear, X-ray, Multi-modality

“Small” Physics Instrumentation: POC, bedside, benchtop, wear/implant

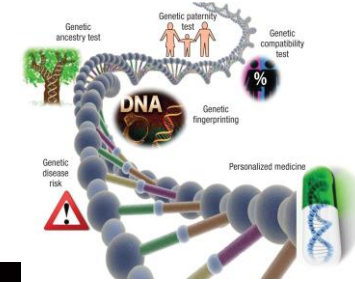
Vision for Future of Health



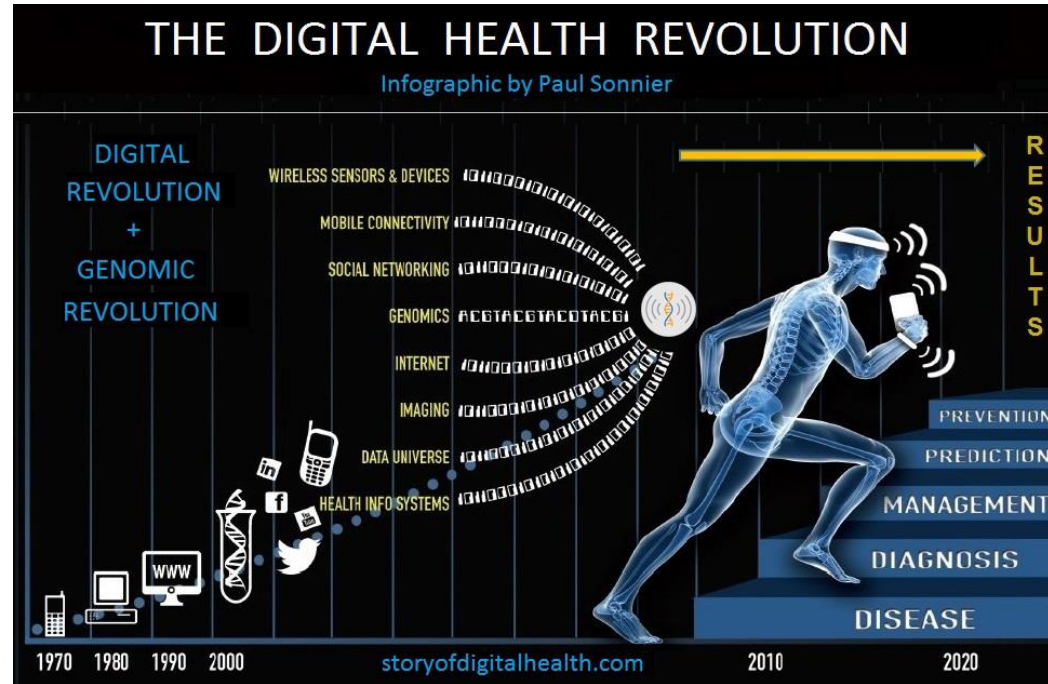
Current Medicine:
Static “Snapshots”



Vision for Future of Health



Future Medicine:
*Dynamic data,
Digital Health*



Time




Vision for Future of Health


US All of Us *at least 1,000,000* participants (2018)

U.S. Department of Health & Human Services National Institutes of Health

NIH National Institutes of Health
All of Us Research Program

ABOUT ▾ FUNDING ▾ NEWS, EVENTS, & MEDIA

[JoinAllofUs.org](#) > Search 



The future of health begins with you

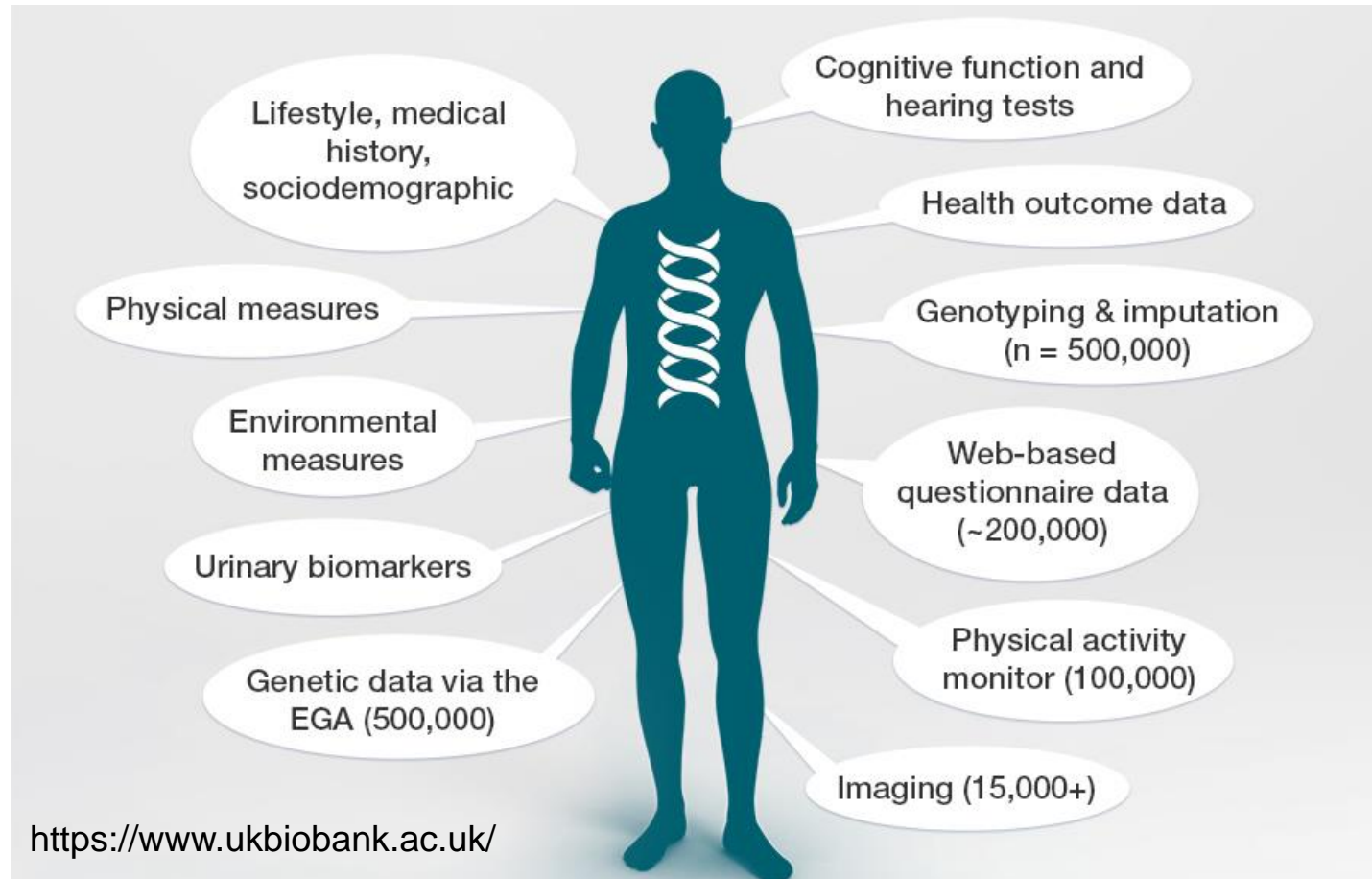
The *All of Us* Research Program is a historic effort to gather data from one million or more people living in the United States to accelerate research and improve health. By taking into account individual differences in lifestyle, environment, and biology, researchers will uncover paths toward delivering precision medicine.

[JOIN NOW](#)

<https://allofus.nih.gov>

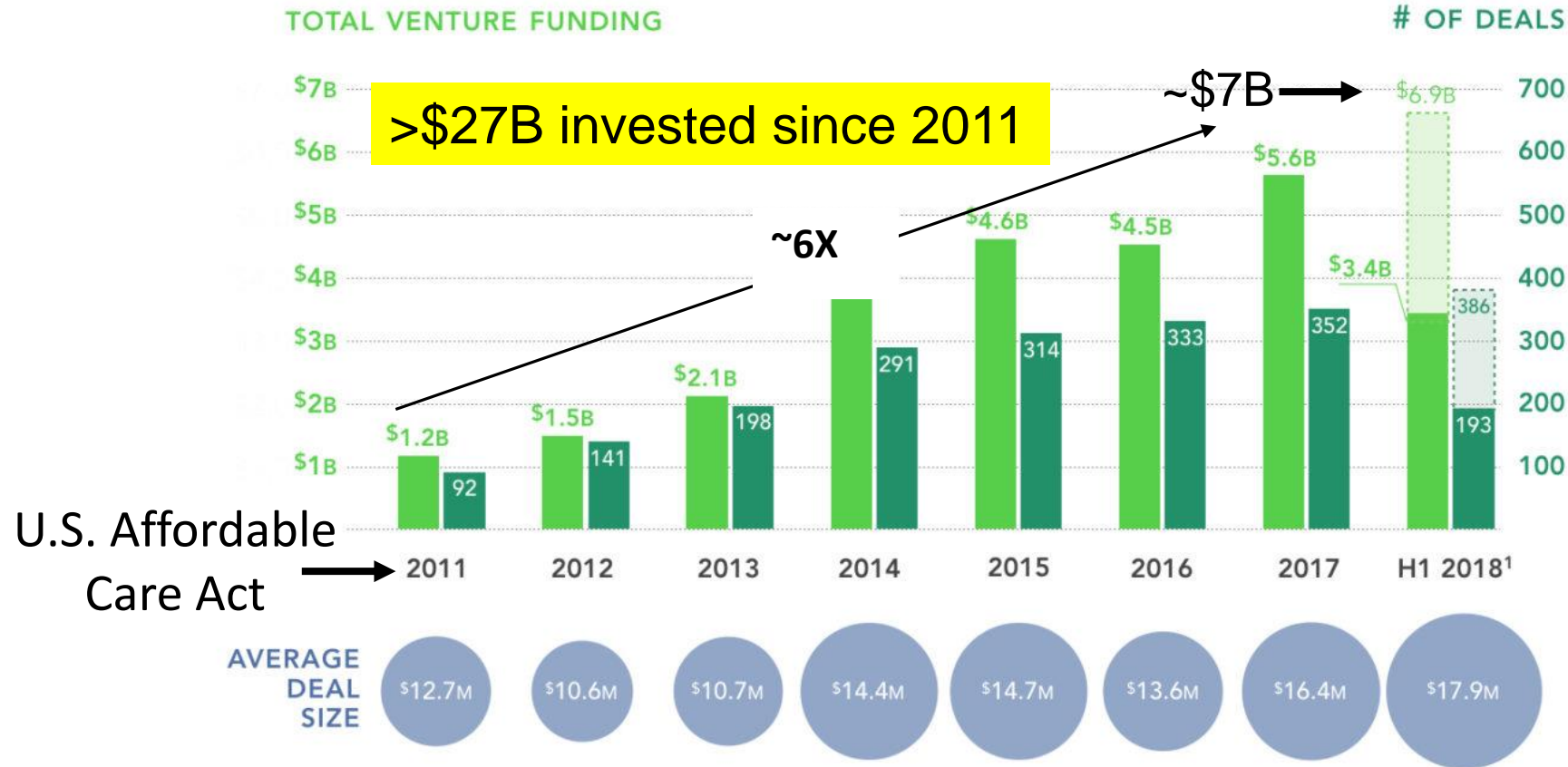
Vision for Future of Health

UK Biobank *up to 500,000* participants (2006)



Digital Health Economic Impact

DIGITAL HEALTH FUNDING
2011-H1 2018



Source: Rock Health Funding Database
 1: Shaded portion shows projections for entire year of 2018, assuming current funding pace continues.
 Note: Only includes U.S. deals >\$2M; data through June 30, 2018

Digital Health Economic Impact

Top 6 Digital Health Investment Areas in 2017

ROCK
HEALTH



1) Health Information



2) Precision Medicine



3) Fitness/Wellness



4) Monitor Disease



5) Diagnosing Disease



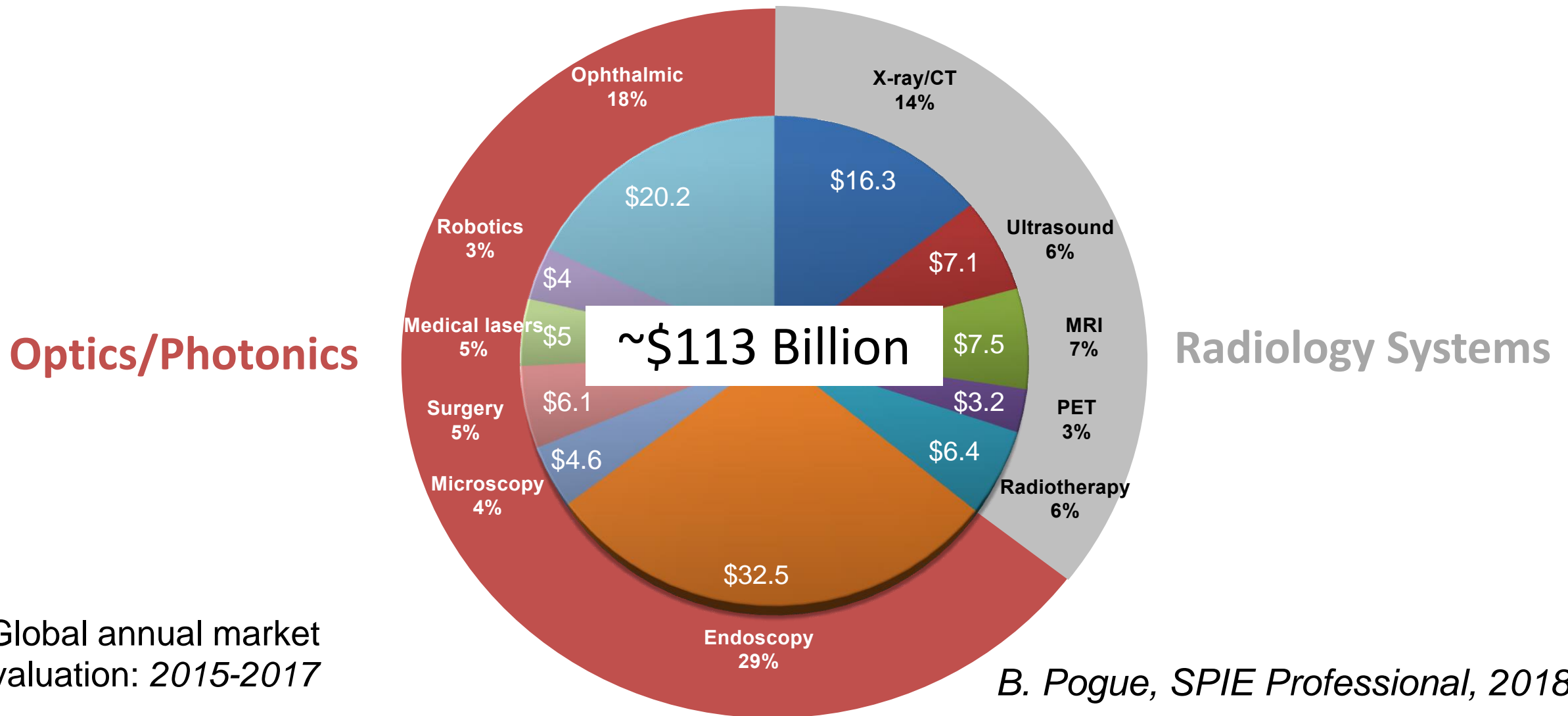
6) Optimizing Workflow

Source: Rock Health Funding Database

Note: Only includes U.S. deals >\$2M; data through December 31, 2017

Each company in the Rock Health Digital Health Funding Database is tagged with at least one and up to three "value propositions." Since each company may fall into multiple value propositions, the sum of the funds raised across value propositions does not sum to the total funds raised.

Medical Imaging Economic Impact

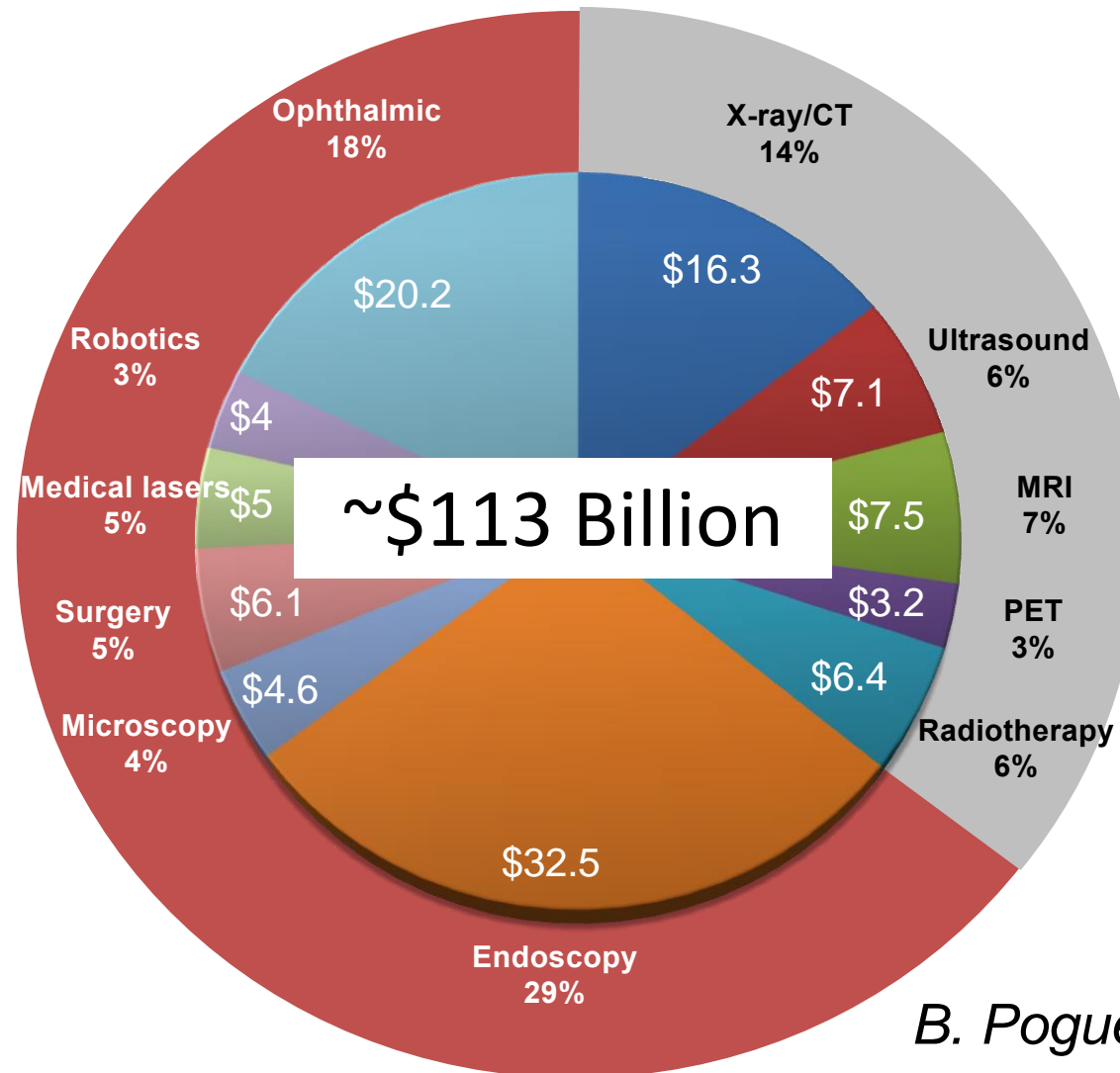


Medical Imaging Economic Impact

~25% of Global Medical Device Market

Optics/Photonics

Radiology Systems



Global annual market valuation: 2015-2017

B. Pogue, SPIE Professional, 2018

Summary

Personalized Health

- Continuous dynamic Biology requires continuous sensing and feedback
- Essential signals for understanding and practicing future Medicine

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Technologies

- Advanced components and materials reduce barriers, improve access
- Accelerate validation, improve patient outcomes, democratize

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BIG Impact

- *Prevent disease, Reduce hospitalizations & costs, Drive economic growth*